

What is claimed is:

1 1: A method of establishing at least two node-disjoint paths comprising:
2 establishing a first directed path, having direction based path segments, from a
3 source node to a target node;
4 establishing a second directed path, having direction based path segments, from a
5 source node to a target node;
6 merging the first and second directed paths into a merged path; and
7 dividing the merged path into a third and a fourth node-disjoint directed paths
8 between the source node and the target node.

1 2: The method of claim 1, wherein establishing the first directed path includes utilizing
2 either a Generic Route Discovery Procedure or the Dynamic Source Routing protocol.

1 3: The method of claim 2, wherein establishing the second directed path includes
2 utilizing a Generic Route Discovery Procedure.

1 4: The method of claim 3, wherein utilizing the Generic Route Discovery Procedure
2 includes:
3 broadcasting a route request;
4 broadcasting information about the first directed path with the route request;
5 forwarding the route request via receiving nodes until the request is received by

6 the target node;
7 building the second directed path having path segments utilizing the path
8 segments that the route request has traveled; and
9 preventing the second directed path from including directed path segments found
10 in the first directed path.

1 5: The method of claim 3, wherein establishing the first directed path and establishing
2 the second directed path each include
3 broadcasting an on-demand flooding route request.

1 6: The method of claim 4, wherein establishing the first directed path and establishing
2 the second directed path occur substantially simultaneously.

1 7: The method of claim 1, wherein merging the first and second directed paths into a
2 merged path includes:
3 adding the first directed path to the second directed path in such a manner that the
4 direction based path segments of opposite direction are removed from the merged path.

1 8: The method of claim 7, wherein adding the first directed path to the second directed
2 path includes utilizing a substantially vector based addition.

1 9: The method of claim 7, wherein adding the first directed path to the second directed
2 path includes:

3 determining if two path segments are between the same nodes but of opposite
4 direction;
5 if so, removing both path segments from the merged path; and
6 repeating the determination and removal until all such paths segments are
7 removed from the merged path.

1 10: The method of claim 1, wherein merging the first and second directed paths into a
2 merged path includes:

3 adding the first directed path to the second directed path to form a closed polygon;
4 removing any interior path segments from the closed polygon; and
5 wherein the merged path is the exterior path segments of the closed polygon.

1 11: The method of claim 10, wherein dividing the merged path into a third and a fourth
2 node-disjoint directed paths includes:

3 determining which path segments of the closed polygon would be traversed if a
4 transmission occurred between the source node and the target node in a clock-wise
5 direction;

6 making the third path the clock-wise path segments; and
7 making the fourth path the counter-clock wise path segments.

1 12: The method of claim 11, wherein dividing the merged path into a third and a fourth
2 node-disjoint directed paths includes:

3 creating the third path utilizing a first portion of the path segments from the first
4 directed path and a first portion of the path segments from the second directed paths; and
5 creating the fourth path utilizing a second portion of the path segments from the
6 first directed path and a second portion of the path segments from the second directed
7 paths.

1 13: The method of claim 1, wherein the two-node disjoint paths include both wireless
2 path segments and wired path segments.

- 1 14. A source node comprising:
 - 2 a transceiver to transmit and receive a wireless signal;
 - 3 a path generator to establish at least a first plurality of paths of communication,
 - 4 utilizing at least in part a wireless signal, between the source node and a target node;
 - 5 a path organizer to arrange a first plurality of paths generated by the path
 - 6 generator into a second plurality of paths that are node disjoint.

1 15. The source node of claim 14, wherein the path generator is capable of generating a
2 first directed path and a second directed path, each directed path having direction based
3 path segments.

1 16. The source node of claim 15, wherein the path generator is capable of generating a
2 path utilizing a Generic Route Discovery Procedure.

1 17. The source node of claim 14, wherein the path generator is capable of generating:
2 the first path utilizing a Generic Route Discovery Procedure utilizing an empty
3 reference path, and
4 the second path utilizing a Generic Route Discovery Procedure utilizing the first
5 path as the reference path.

1 18. The source node of claim 14, wherein the path generator is capable of generating the
2 second path via:
3 broadcasting a route request;
4 broadcasting information about the first directed path with the route request;
5 directing receiving nodes to forward the route request via receiving nodes until
6 the request is received by the target node;

7 directing receiving nodes to build the second directed path having path segments
8 utilizing the path segments that the route request has traveled; and
9 directing receiving nodes to prevent the second directed path from including
10 directed path segments found in the first directed path.

1 19. The source node of claim 18, wherein the path generator is capable of:
2 establishing the first and second paths substantially simultaneously.

- 1 20. The source node of claim 14, wherein the path organizer is capable of:
 - 2 combining the first plurality of paths into a merged path, and
 - 3 dividing the merged path into a second plurality of paths that are node disjoint.

1 21. The source node of claim 20, wherein the first plurality of paths, includes a plurality
2 of directed paths, each directed path having direction based path segments; and
3 wherein the path organizer is capable of combining the first set of paths into a
4 merged path via adding the first set of paths together, such that path segments of opposite
5 directions cancel out.

1 22. The source node of claim 21, wherein the path organizer is capable of combining the
2 first set of paths into a merged path utilizing a substantially vector based addition.

1 23. The source node of claim 21, wherein the path organizer is capable of:
2 determining if two path segments are between the same nodes but of opposite
3 direction;
4 if so, removing both path segments from the merged path; and
5 repeating the determination and removal until all such paths segments are
6 removed from the merged path.

1 24. The source node of claim 20, wherein the first plurality of paths, includes a plurality
2 of directed paths, each directed path having direction based path segments; and
3 wherein the path organizer is capable of:
4 graphically adding the first plurality of paths together to form a closed polygon;
5 removing any interior path segments from the closed polygon;
6 wherein the merged path is the exterior path segments of the closed polygon; and
7 dividing the merged path into a second plurality of node disjoint paths.

1 25. The source node of claim 14, wherein the transceiver is capable of sending a wireless
2 signal to a target node utilizing any one of the paths of the second plurality of paths that
3 are node disjoint.

1 26: An article comprising:
2 a storage medium having a plurality of machine accessible instructions, wherein when the
3 instructions are executed, the instructions provide for:
4 establishing a first directed path, having direction based path segments, from a
5 source node to a target node;
6 establishing a second directed path, having direction based path segments, from a
7 source node to a target node;
8 merging the first and second directed paths into a merged path; and
9 dividing the merged path into a third and a fourth node-disjoint directed paths.

1 27: The article of claim 26, wherein the instructions providing for establishing the first
2 directed path includes instructions providing for utilizing either a Generic Route
3 Discovery Procedure or the Dynamic Source Routing protocol.

1 28: The article of claim 27, wherein the instructions providing for establishing the
2 second directed path includes instructions providing for utilizing a Generic Route
3 Discovery Procedure.

1 29: The article of claim 28, wherein the instructions providing for utilizing the Generic
2 Route Discovery Procedure includes instructions providing for:
3 broadcasting a route request;

4 broadcasting information about the first directed path with the route request;
5 forwarding the route request via receiving nodes until the request is received by
6 the target node;
7 building the second directed path having path segments utilizing the path
8 segments that the route request has traveled; and
9 preventing the second directed path from including directed path segments found
10 in the first directed path.

1 30: The article of claim 28, wherein the instructions providing for establishing the first
2 directed path and establishing the second directed path each include instructions
3 providing for:
4 broadcasting an on-demand flooding route request.

1 31: The article of claim 29, wherein establishing the first directed path and establishing
2 the second directed path occur substantially simultaneously.

1 32: The article of claim 26, wherein the instructions providing for merging the first and
2 second directed paths into a merged path includes instructions providing for:
3 adding the first directed path to the second directed path in such a manner that the
4 direction based path segments of opposite direction are removed from the merged path.

1 33: The article of claim 32, wherein the instructions providing for adding the first
2 directed path to the second directed path includes instructions providing for utilizing a
3 substantially vector based addition.

1 34: The article of claim 32, wherein the instructions providing for adding the first
2 directed path to the second directed path includes instructions providing for:
3 determining if two path segments are between the same nodes but of opposite
4 direction;
5 if so, removing both path segments from the merged path; and
6 repeating the determination and removal until all such paths segments are
7 removed from the merged path.

1 35: The article of claim 26, wherein the instructions providing for merging the first and
2 second directed paths into a merged path includes instructions providing for:
3 adding the first directed path to the second directed path to form a closed polygon;
4 removing any interior path segments from the closed polygon; and
5 wherein the merged path is the exterior path segments of the closed polygon.

1 36: The article of claim 35, wherein the instructions providing for dividing the merged
2 path into a third and a fourth node-disjoint directed paths includes instructions providing
3 for: .

4 determining which path segments of the closed polygon would be traversed if a
5 transmission occurred between the source node and the target node in a clock-wise
6 direction;

7 making the third path the clock-wise path segments; and

8 making the fourth path the counter-clock wise path segments.

1 37: The article of claim 36, wherein the instructions providing for dividing the merged
2 path into a third and a fourth node-disjoint directed paths includes instructions providing
3 for:

4 creating the third path utilizing a first portion of the path segments from the first
5 directed path and a first portion of the path segments from the second directed paths; and

6 creating the fourth path utilizing a second portion of the path segments from the
7 first directed path and a second portion of the path segments from the second directed
8 paths.

1 38: The article of claim 26, wherein the two-node disjoint paths include both wireless
2 path segments and wired path segments.

1 39. A system comprising:

2 a target node,

3 at least one repeater node, and

4 a source node including:

5 a transceiver to transmit and receive a wireless signal;

6 a path generator to establish at least a first plurality of paths of

7 communication, utilizing at least in part a wireless signal, between the source node and a

8 target node;

9 a path organizer to arrange a first plurality of paths generated by the path

10 generator into a second plurality of paths that are node disjoint.

1 40. The system of claim 39, wherein the path generator is capable of generating a first

2 directed path and a second directed path, each directed path having direction based path

3 segments.

1 41. The system of claim 40, wherein the path generator is capable of generating a path

2 utilizing a Generic Route Discovery Procedure.

1 42. The system of claim 39, wherein the path generator is capable of generating:

2 the first path utilizing a Generic Route Discovery Procedure utilizing an empty

3 reference path, and

4 the second path utilizing a Generic Route Discovery Procedure utilizing the first
5 path as the reference path.

- 1 43. The system of claim 39, wherein the path generator is capable of generating the
- 2 second path via:
 - 3 broadcasting a route request;
 - 4 broadcasting information about the first directed path with the route request;
 - 5 directing the repeater node to forward the route request via repeater nodes until
 - 6 the request is received by the target node;
 - 7 directing repeater nodes to build the second directed path having path segments
 - 8 utilizing the path segments that the route request has traveled; and
 - 9 directing repeater nodes to prevent the second directed path from including
 - 10 directed path segments found in the first directed path.

1 44. The system of claim 43, wherein the path generator is capable of:
2 establishing the first and second paths substantially simultaneously.

- 1 45. The system of claim 39, wherein the path organizer is capable of:
 - 2 combining the first plurality of paths into a merged path, and
 - 3 dividing the merged path into a second plurality of paths that are node disjoint.

1 46. The system of claim 45, wherein the first plurality of paths, includes a plurality of
2 directed paths, each directed path having direction based path segments; and
3 wherein the path organizer is capable of combining the first set of paths into a
4 merged path via adding the first set of paths together, such that path segments of opposite
5 directions cancel out.

1 47. The system of claim 46, wherein the path organizer is capable of combining the first
2 set of paths into a merged path utilizing a substantially vector based addition.

1 48. The system of claim 46, wherein the path organizer is capable of:
2 determining if two path segments are between the same nodes but of opposite
3 direction;
4 if so, removing both path segments from the merged path; and
5 repeating the determination and removal until all such paths segments are
6 removed from the merged path.

1 49. The system of claim 45, wherein the first plurality of paths, includes a plurality of
2 directed paths, each directed path having direction based path segments; and
3 wherein the path organizer is capable of:

4 graphically adding the first plurality of paths together to form a closed polygon;
5 removing any interior path segments from the closed polygon;
6 wherein the merged path is the exterior path segments of the closed polygon; and
7 dividing the merged path into a second plurality of node disjoint paths.

1 50. The system of claim 49, wherein the transceiver is capable of sending a wireless
2 signal to a target node utilizing any one of the paths of the second plurality of paths that
3 are node disjoint.

1 51. The system of claim 39, wherein
2 the path generator is capable of generating the second path via:
3 broadcasting a route request, and
4 broadcasting information about the first directed path with the route
5 request;
6 the at least one repeater node is capable of
7 forwarding the route request, via other repeater nodes if any, until the
8 request is received by the target node,
9 building the second directed path having path segments utilizing the path
10 segments that the route request has traveled, and
11 determining if the most recent directed path segment is found in either the
12 first directed path or the second directed path,
13 if so, ignoring the routing request, and

14 if not, placing the most recent path segment in the second directed
15 path.

- 1 52. The system of claim 51, wherein
- 2 the target node is capable of:
 - 3 receiving the route request, and
 - 4 transmitting a route reply, having the second directed path, to the source
 - 5 node; and
- 6 the source node is capable of:
 - 7 receiving the route reply, having a received path,
 - 8 determining if a route reply correlating to the route request has already
 - 9 been received;
 - 10 if so, ignoring the route reply, and
 - 11 if not, utilizing the received path as the second directed path.

- 1 53. A method comprising:
 - 2 broadcasting, from a source node, a route request,
 - 3 wherein the route request is utilized to establish a new path to a target
 - 4 node and includes a reference path and an empty route record;
 - 5 a receiving node receiving a route request;
 - 6 determining if the route request should be ignored;
 - 7 if not, adding the most recent path segment to the route record, and

8 forwarding the route request until it is received by the target node;
9 broadcasting a route reply, having the route record, from the target node to the
10 source node;
11 determining if the route reply should be ignored;
12 if not, utilizing the route record to communicate between the source and target
13 nodes.

1 54. The method of claim 53, wherein:
2 broadcasting a route request includes broadcasting a first route request having an
3 empty reference path;
4 utilizing the route record includes making the route record the reference path; and
5 the method further includes
6 repeating the method of claim 53 wherein broadcasting a route request includes
7 broadcasting a second route request having a reference path substantially equal to the
8 route record resulting from the first route request.

1 55. The method of claim 53, wherein determining if the route request should be ignored
2 includes:
3 determining if the receiving node has previously processed this route request;
4 determining if the most recent path segment is part of the reference path; and
5 if either condition is met, ignoring the route request.

1 56. The method of claim 55, wherein forwarding the route request until it is received by
2 the target node includes:
3 determining if the receiving node is the target node; and
4 if not, rebroadcasting the route request.

1 57. The method of claim 56, wherein determining if the route reply should be ignored
2 includes:
3 determining if the route reply is the first route reply received as a result of the
4 route request; and
5 if so, ignoring the route reply.

1 58. The method of claim 57, wherein utilizing the route record to communicate between
2 the source and target nodes includes:
3 determining if the reference path of the corresponding route request was empty;
4 if so, making the route record the reference path and repeating the method with
5 the new reference path.

1 59. The method of claim 58, wherein utilizing the route record to communicate between
2 the source and target nodes includes:

3 if the reference path of the corresponding route request was not empty,
4 setting an augmented path to the received route record; and
5 converting the reference path and augmented path into two node disjoint paths.

1 60. The method of claim 59, wherein converting the reference path and augmented path
2 into two node disjoint paths includes:
3 adding the reference path to the augmented path to form a merged path
4 wherein adding is done in such a manner that the direction based path
5 segments of opposite direction are removed from the merged path; and
6 dividing the merged path into a first and a second node-disjoint directed paths.

1 61. The method of claim 59, wherein converting the reference path and augmented path
2 into two node disjoint paths includes:
3 adding the reference path to the augmented path to form a closed polygon;
4 removing any interior path segments from the closed polygon; and
5 wherein a merged path is the exterior path segments of the closed polygon; and
6 dividing the merged path into a first and a second node-disjoint directed paths.